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Microbiological Qualities of Hawked Retted Cassava Fufu in Aba Metropolis of Abia State

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ABSTRACT

Retted cassava fufu samples obtained from five local government areas in Aba Metropolis were analyzed. Their microbial counts, chemical and organoleptic properties were determined from the day of preparation and every day for the eight days of hawking. There were increases in the microbial counts from initial average of 2.02 x 10^5 cfu /g on the zero day to an average counts of 18.70 x 10^5 cfu/g on the eighth-day. The microorganisms associated with spoilage were found to be *Bacillus cereus*, *Staphylococcus aureus*, *Escherichia coli*, *Candida albicans* and *Aspergillus spp*. The chemical qualities as determined on the freshly prepared fufu samples from all the local government areas were comparable. The colour, odour and texture of the freshly prepared samples were acceptable and rated high by the panelists. It was observed that as the days of hawking of the fufu samples increased, the organoleptic qualities decreased. The pH increased from an average of 3.85 on the zero day to 4.25 average on the eighth day. The titratable acidity decreased from 1.14% on the zero day to 0.94% on the eighth day. The results are discussed in relation to the public health implications of hawked retted cassava fufu.

Keywords: Retted cassava, fufu, spoilage, organoleptic quality.

Introduction

Retted cassava fufu is a wet-paste made from fermented cassava (Oyewole and Sanni, 1985). Details and methods of fufu preparation vary from locality to locality, which greatly affect the quality of the finished product (Okpokiri *et al.*, 1985). It is consumed as a staple food in most South-eastern states of Nigeria and cooked in various villages and rural areas where cassava is grown in large quantities by farmers.

One important aspect of retted cassava fufu which has not attracted much attention is the microbiological safety of hawked cassava fufu. Although there are no reported cases of food poisoning resulting from consumption of retted cassava fufu, some cases have been reported as a result of ingestion of some other food types.

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Cassava and its products, like other food materials, have the potential for supporting the growth of both pathogenic and spoilage microorganisms (Obadina *et al.*, 2006). The microorganisms can be introduced directly from handlers or the environment during processing, transportation, storage and hawking. This study therefore aimed at investigating the effects of handling and hawking on the chemical, microbiological and organoleptic qualities of retted cassava fufu.

Materials and Methods

Aba Metropolis in Abia State was used as a study area. Retted cassava fufu samples were bought from each of the five local government areas within and around Aba metropolis: Osisioma (FUEK), Ugwunabo (FUUM), Aba South (FUNE), Aba North (FUAR) and Obingwa (FUIT). They were marked and given to a retted cassava fufu hawker in the same area who mixed them with her wares and hawked them together. Each marked wrapped sample was collected from the hawker every day

for analysis. Samples were collected with sterile containers and covered immediately, and were taken to the laboratory for analysis.

Microbiological analysis

One gram from each of the fufu wraps was separately homogenized in 9.0 ml of sterile peptone water. The dilution was serially made until 10^{-5} level of dilution was obtained. Isolation and identification was done according to the method of Ogbulie *et al.* (2005) and ICMMSF (1978). For bacterial isolation, nutrient agar, macConkey agar were used, while sabouraud dextrose agar was used for fungi isolation. Total viable counts of bacteria were determined by enumerating the colony forming units (cfu/g) by pour plating 1.0 ml of 10^{-5} diluent incubated at 37°C for 48 h. Total fungi counts were determined by pour plating also and incubated at 37°C for 3 days. The experiments were carried out in triplicates. Pure cultures of bacteria and fungal isolates were obtained on the nutrient agar and sabouraud dextrose agar respectively.

Characterization and identification of isolates

Bacteria isolates were characterized and identified by initially examining colonies macroscopically on their cultural properties followed by physiological and biochemical tests. (Motility test, citrate test, coagulase test, indole test, starch fermentation test, gram stain, spore stain catalase test and oxidase test, etc.) The fungal isolates were characterized by their cultural properties stained with cotton-blue lactophenol solution and observed under low power objective lens (Chessbrough, 2002; Kovac, 1956; ICMMSF, 1978; Ogbulie *et al.*, 2005).

Chemical and organoleptic analysis

The pH and total titratable acidity were determined using AOAC (1990) method. A 20-man member panel was used for the organoleptic evaluation of colour, odour and texture based on a 5-point hedonic scale (Iwe, 2002).

Data statistical analysis

All plates were prepared in triplicates. The plate counts were expressed in colony forming unit (cfu/g). The pH and total titratable acidity were also done in triplicates. Data obtained were subjected to statistical analysis according to Ihekoronye (1999). Significance differences were established by Duncan multiple range test at 5% level of significance.

Results and Discussion

Table 1 shows rapid increases in the microbial count among the samples. On the initial day, FUIT, FUNE, FUUM, FUEK and FUAR recorded 1.90 x 10^5 (cfu/g), 1.40 x 105^5 (cfu/g), 1.10 x10^6 (cfu/g), 2.80 x 10^5 (cfu/g) and 2.90 x 10^5 (cfu/g) respectively. On the eighth day of hawking, the microbial counts were 18.80 x 10^5 cfu/g, 18.30 x 10.5 (cfu/g), 17.00 x 10^5 (cfu/g), 19.10 x 10^5 (cfu/g) and 19.10 x10^5 (cfu/g) respectively. This indicates that the storage temperature, moisture content, pH and the nutrient content in the fufu samples favoured the growth of microorganisms. Table 2 shows the dominant microorganisms isolated from all the samples. The organisms were *Staphylococcus aureus*, *Bacillus cereus*, *Candida albicans*, *Escherichia coli* and *Aspergillus* spp. Isolation of these organisms is an indication of post-processing contamination as a result of unhygienic handling and it is of very paramount public health concern.

The high temperature commonly involved in the preparation of retted cassava fufu is sufficient to eliminate most of the microorganisms but post-processing contamination may occur which would affect the quality of the final product. The food may be contaminated during mixing, kneading, moulding and hawking. The presence of *Stapylococcus aureus* in the samples is due to contamination from the skin, mouth, or nose of the handlers or hawkers.

Bacillus cereus, an opportunistic pathogen of humans, is a frequent inhabitant of soil, leaf surfaces and wrapping materials. Its presence in the fufu might be due to the materials used in wrapping and packaging.

Aspergillus spp in the food may lead to food poisoning, since many of these fungi are toxin producing organisms, ubiquitous in the environment

Table 1: Microbial counts of stored retted cassava fufu

Time	Microbial counts x 10^5 cfu					
(Days)	FUIT	FUNE	FUUM	FUEK	FUAR	LSD
0	1.90 ± 0.04^{b}	1.40 ± 0.04^{c}	1.10 ± 0.04^{d}	2.80 ± 0.08^{a}	2.90 ± 0.04^{a}	0.29
1	2.10 ± 0.04^{a}	2.30 ± 0.04^{a}	1.90 ± 0.04^{d}	3.10 ± 0.04^{b}	3.10 ± 0.04^{b}	0.13
2	3.30 ± 0.04^{a}	3.60 ± 0.4^{b}	3.00 ± 004^{c}	3.30 ± 0.04^{d}	4.30 ± 0.04^{b}	2.6
3	5.00 ± 0.04^{a}	5.50 ± 004^{c}	4.60 ± 0.04^{d}	6.00 ± 0.04^{b}	5.70 ± 0.04^{c}	0.09
4	7.00 ± 0.04^{a}	6.90 ± 0.04^{a}	5.00 ± 0.04^{a}	7.00 ± 0.04^{a}	7.40 ± 0.04^{a}	8.9
5	8.00 ± 0.08^{a}	8.20 ± 0.04^{b}	7.06 ± 0.01^{a}	9.00 ± 0.04^{a}	9.10 ± 0.03^{a}	2.9
6	10.80 ± 0.04^{a}	11.46 ± 0.04^{b}	11.56 ± 0.94^{c}	13.10 ± 0.08^{a}	13.20 ± 004^{a}	1.5
7	14.6 ± 0.08^{a}	14.36 ± 0.12^{d}	13.80 ± 0.8^{e}	15.45 ± 0.1^{c}	16.40 ± 0.16^{b}	0.37
8	18.8 ± 004^{a}	18.3 ± 0.02^{b}	1700 ± 0.04^{c}	19.10 ± 0.14^{b}	19.10 ± 0.14^{b}	2.36

Values are the means the triplicate determinations ± standard deviations. Means within the rows followed by the same letter(s) are significantly not different from each other.

Table 2: Morphological and biochemical characteristics of bacterial and fungal isolates

Cultural and morphological characteristic	Gram reaction	Mortility	Catalase	Coagulase	Oxidase	Indole	Citrate	Glucose	Sucrose	Mannitol	Lactose	Maltose	Inositol	Dacitoli	
Rose pink round smooth Edge slightly raised Colonies 2-4 um rods on Macconky	– ve rods	+	–	–	–	–	+	–	+	–	–	A	+	+	*Escherichia coli*
Creamy regular smooth raised clonies 1-2 um	+ ve coci	–	+	+	–	–	–	A	+	A	–	A	+	+	*Staphylococcus aureus*
Grey round and wavy edge Flat and irregular rods 2-5 um	+ ve rods	–	+	–	+	–	+	A	A	A	A	A	–	–	Bacillus cereus
Key	+ = positive, – = negative, A = acid production														
	FOR FUNGI														
Cultural Identification	Staining									Identified Isolates					
whitish irregular and slightly rounded and dry on saboured dextrose agar	+ ve cocci with pseudo hyphae									Candida albicans					
Black irregular dry and poundery	+ ve with hyphae									Aspergillus spp.					

and originated from the market display areas. The presence of *E. coli* in the food indicates that such fufu has been contaminated with faecal materials and such food is not safe for human consumption.

The presence of higher number of these organisms as the day of hawking increases indicates a progressive proliferation with negative effects on nutritional quality, medicinal and organoleptic properties since many key nutrients will be broken down and utilized by the spoiling agents (Bueno *et al.*, 2004).

Table 3: pH of retted cassava fufu stored for various days under ambient temperature

Time (Days)	Sample pH FUIT	FUNE	FUUM	FUEK	FUAR	LSD
0	3.90 ± 00[a]	3.80±0.00[a]	3.85 ± 0.00[a]	3.90 ± 0.00[a]	3.80 ± 0.00[a]	0
1	3.95 ± 0.00[a]	3.85 ± 0.00[a]	3.90± ± 0.00[a]	3.95 ± 0.00[a]	3.85 ± 0.00[a]	0
2	4.00 ± 0.00[a]	3.90 ± 0.00[a]	3.99 ± 0.00[a]	4.00 ± 0.00[a]	3.91 ± 0.00[a]	0
3	4.10 ± 0.00[a]	3.95 ± 0.00[a]	4.00 ± 0.00[a]	4.10 ± 0.00[a]	3.96 ± 0.00[a]	0
4	4.15 ± 0.00[a]	4.15 ± 0.00[a]	4.15 ± 0.00[a]	4.15 ± 0.00[a]	4.10 ± 0.00[a]	0
5	4.20 ± 0.00[a]	4.20 ± 0.00[a]	4.15 ± 0.00[a]	4.20 ± 0.00[a]	4.10 ± 0.00[a]	0
6	4.20 ± 0.00[a]	4.25 ± 0.00[a]	4.20 ± 0.00[a]	4.20 ± 0.00[a]	4.15 ± 0.00[a]	0
7	4.20 ± 0.00[a]	435 ± 0.00[a]	4.20 ± 0.00[a]	4.20 ± 0.00[a]	4.18 ± 0.00[a]	0
8	4.25 ± 0.00[a]	4.35 ± 0.00[a]	4.22 ± 0.00[a]	4.21 ± 0.00[a]	4.19 ± 0.00[a]	0

Values are the means of triplicate ± standard deviations. Means within the rows followed by the same letter are significantly not different from each other.

Table 4: Total titratable acidity of retted cassava fufu stored for various days

Time (Days)	Sample Total Titratable Acidity FUIT	FUNE	FUUM	FUEK	FUAR	LSD
0	1.08 ± 0.02[c]	1.24 ± 0.5[b]	1.16 ± 0.01[d]	0.96 ± 0.0[d]	1.23 ± 0.02[a]	0.22
1	1.03 ± 0.4[d]	1.17 ± 0.04[c]	1.13 ± 0.01[b]	0.96 ± 0.1[e]	1.18 ± 0.02[a]	0.04
2	0.99 ± 0.1[b]	1.00 ± 0.1[b]	0.99 ± 0.04[b]	0.95 ± 0.1[b]	1.11 ± 0.1[a]	1.5
3	0.99 ± 0.1[b]	0.99 ± 0.02[b]	0.99 ± 0.01[c]	0.94 ± 0.01[c]	1.10 ± 0.01[a]	0.07
4	0.96 ± 0.01[a]	0.99 ± 0.01[a]	0.98 ± 0.1[a]	0.93 ± 0.01[b]	0.99 ± 0.06[a]	0.22
5	0.96 ± 0.01[a]	0.98 ± 0.01[a]	0.97 ± 0.01[a]	0.93 ± 0.01[b]	0.99 ± 0.01[a]	0.22
6	0.95 ± 0.01[a]	0.98 ± 0.01[a]	0.97 ± 0.01[a]	0.92 ± 0.01[a]	0.98 ± 0.00[a]	2.6
7	0.95 ± 0.01[a]	0.98 ± 0.01[a]	0.96 ± 0.01[a]	0.92 ± 0.01[a]	0.97 ± 0.01[a]	2.6
8	0.95 ± 0.1[a]	0.97 ± 0.1[a]	0.96 ± 0.01[a]	0.92 ± 0.01[a]	0.97 ± 0.01[a]	2.6

Values are the means of triplicate determination ± standard deviations. Means within the rows followed by the same letter are significantly not different from each other.

Table 3 shows the pH values of the different samples. All the fufu samples had acidic pH and this is in line with the report of Adewole (2005) and Achi and Akoma (2006) which stated that the pH value of the cooked retted cassava fufu falls within the pH range of (3.65 – 5.12). This acidic pH may have restricted the growth of certain microorganisms. As the days of hawking increased the pH increased from 3.90 to 4.25, allowing the growth of the pathogenic and spoilage organisms. Increasing pH of food during storage has been attributed to the release of ammonia by spoilage microorganisms (Sarkar *et al*., 2006; Olawepo *et al*., 2001). The total titratable acidity decreased as the pH increased. From Table 4 it was observed that the sensory qualities decreased with increase in the number of days of hawking for all the samples. The colour, odour and texture were appreciated on the first day. On the eighth day different colours were seen on the retted cassava fufu. The different colours were as a result of biochemical changes and conspicuous growth of different microorganisms.

Table 5: Sensory evaluation scores of colour for stored retted cassava fufu

Time (Days)	Sample and their Scores				
	FUIT	**FUNE**	**FUUM**	**FUEK**	**FUAR**
0	4.8 ± 0.49	4.6 ± 0.49	4.5 ± 0.30	4.4 ± 0.49	4.40 ± 0.40
1	4.6 ± 0.69	4.5 ± 0.50	4.40 ± 0.66	4.4 ± 0.46	4.3 ± 0.46
2	3.9 ± 0.42	3.6 ± 0.49	3.6 ± 0.48	3.4 ± 0.52	3.2 ± 0.56
3	3.8 ± 0.44	3.6 ± 0.49	3.5 ± 0.50	3.4 ± 0.52	3.2 ± 0.56
4	2.6±0.50	2.5 ± 0.50	2.5 ± 0.50	2.4 ± 0.50	2.2 ± 0.50
5	2.6 ± 0.50	2.5 ± 0.50	2.5 ± 0.50	2.4 ± 0.50	2.2 ± 0.50
6	2.1 ± 0.30	2.2 ± 0.57	1.9 ± 0.30	1.5 ± 0.50	1.3 ± 0.50
7	1.9 ± 0.30	1.8 ± 0.41	1.5 ± 0.50	1.3 ± 0.50	1.3 ± 0.50
8	1.3 ± 0.50	1.3 ± 0.50	1.2 ± 0.50	1.2 ± 0.50	1.1 ± 0.50

Values are the means of triplicate ± standard deviation.

Conclusion

Retted cassava fufu are unsafe for consumption after the third day of production when hawked at ambient temperature because of the proliferation of microorganisms. Adequate sanitation practice should be enforced concerning the sale of retted cassava fufu. Personal hygiene of hawkers and sanitation of utensils are important. Hawkers should be enlightened on hygienic practices.

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